

What is claimed is:

1. An apparatus for compensating or generating polarization mode dispersion (PMD) for an optical fiber, comprising:
 - means for controlling the magnitude of the first and second order PMD in a lightwave signal, and
 - means for controlling the direction of the first and second order PMD in the lightwave signal.
2. The apparatus of claim 1, wherein the magnitude of the first order PMD is controlled separately from the magnitude of the second order PMD.
3. The apparatus of claim 2, wherein the means for controlling the magnitude of the first order PMD comprises:
 - first means for producing a first portion of the desired first order PMD magnitude and a first determined amount of second order PMD,
 - second means for producing a second portion of the desired first order PMD magnitude and a second determined amount of second order PMD, and
 - first tuning means for adjusting a coupling of the first means and second means to produce the full amount of desired first order PMD magnitude and to produce no second order PMD.
4. The apparatus of claim 3, wherein the means for controlling the direction of first and second order PMD includes means for aligning the produced first order PMD magnitude to cancel the first order PMD of the optical fiber.
5. The apparatus of claim 2, wherein the means for controlling the magnitude of the second order PMD comprises:

third means for producing a first portion of the desired second order PMD magnitude and a first determined amount of first order PMD,

fourth means for producing a second portion of the desired second order PMD magnitude and a second determined amount of first order PMD, and

second tuning means for adjusting a coupling of the first means and second means to produce the full amount of desired second order PMD magnitude and to produce no first order PMD.

6. The apparatus of claim 5, wherein the means for controlling the direction of first and second order PMD includes means for aligning the produced second order PMD magnitude to cancel the second order PMD of the optical fiber.

7. A method for compensating or generating polarization mode dispersion (PMD) for an optical fiber, comprising:

controlling the magnitude of the first and second order PMD in a lightwave signal, and controlling the direction of the first and second order PMD in the lightwave signal.

8. The method of claim 7, wherein the magnitude of the first order PMD is controlled separately from the magnitude of the second order PMD.

9. The method of claim 8, wherein controlling the magnitude of the first order PMD comprises:

producing a first portion of the desired first order PMD magnitude and a first determined amount of second order PMD,

producing a second portion of the desired first order PMD magnitude and a second determined amount of second order PMD, and

adjusting a coupling of the first means and second means to produce the full amount of desired first order PMD magnitude and to produce no second order PMD.

10. The method of claim 9, wherein controlling the direction of first and second order PMD includes aligning the produced first order PMD magnitude to cancel the first order PMD of the optical fiber.

11. The method of claim 8, wherein controlling the magnitude of the second order PMD comprises:

producing a first portion of the desired second order PMD magnitude and a first determined amount of first order PMD,

producing a second portion of the desired second order PMD magnitude and a second determined amount of first order PMD, and

adjusting a coupling of the first means and second means to produce the full amount of desired second order PMD magnitude and to produce no first order PMD.

12. The method of claim 11, wherein controlling the direction of first and second order PMD includes aligning the produced second order PMD magnitude to cancel the second order PMD of the optical fiber.

13. An apparatus for compensating polarization mode dispersion (PMD) in a lightwave signal, comprising:

a first module for compensating first order PMD without affecting second order PMD, and

a second module for compensating second order PMD without affecting first order PMD, wherein the first and second modules are separately controlled.

14. The apparatus of claim 13, wherein the first module comprises first and second portions, each for producing second order PMD alterations that cancel each other, and

a tuner for adjusting the coupling of the first and second portions so that each of the first and second portions produces half of the first order PMD alteration.

15. The apparatus of claim 13, wherein the second module comprises first and second portions, each for producing first order PMD alterations that cancel each other, and

a tuner for adjusting the coupling of the first and second portions so that each of the first and second portions produces half of the second order PMD alteration.

16. The apparatus of claim 13, wherein the first module is controlled in a feedforward manner and second module is controlled in a feedback manner.

17. The apparatus of claim 13, wherein the first and second modules are controlled in a feedforward manner.

18. An apparatus for generating polarization mode dispersion (PMD) in a lightwave signal, comprising:

a first module for generating first order PMD without affecting second order PMD, and a second module for generating second order PMD without affecting first order PMD, wherein the first and second modules are separately controlled.

19. The apparatus of claim 18, wherein the first module comprises first and second portions, each for producing second order PMD alterations that cancel each other, and

a tuner for adjusting the coupling of the first and second portions so that each of the first and second portions produces half of the first order PMD alteration.

20. The apparatus of claim 18, wherein the second module comprises first and second portions, each for producing first order PMD alterations that cancel each other, and

a tuner for adjusting the coupling of the first and second portions so that each of the first and second portions produces half of the second order PMD alteration.

21. A module for altering first order polarization mode dispersion (PMD) without altering second order PMD in a lightwave signal, comprising:

first and second portions, each for producing second order PMD alterations that cancel each other, and

a tuner for adjusting the coupling of the first and second portions so that each of the first and second portions produces half of the first order PMD alteration.

22. The module of claim 21, wherein the lightwave signal contains PMD and the module is used to remove PMD.

23. The module of claim 21, wherein the lightwave signal is devoid of PMD and the module is used to generate PMD.

24. The module of claim 21, wherein the tuner is a phase-plate.

25. The module of claim 21, wherein each of the first and second portions includes two fixed differential group delay (DGD) segments and a tuner for coupling the two fixed DGD segments.

26. The module of claim 25, wherein each of the fixed DGD segments is a birefringent crystal.
27. The module of claim 25, wherein each of the fixed DGD segments is a polarization maintaining fiber.
28. The module of claim 25, wherein the fixed DGD segments in the first and second portions are substantially identical.
29. The module of claim 21, wherein the module is fabricated using MEMS technology on a wafer.
30. A module for altering second order polarization mode dispersion (PMD) without altering first order PMD in a lightwave signal, comprising:
 - first and second portions, each for producing first order PMD alterations that cancel each other, and
 - a module tuner for adjusting the coupling of the first and second portions so that each of the first and second portions produces half of the second order PMD alteration.
31. The module of claim 30, wherein the lightwave signal contains PMD and the module is used to remove PMD.
32. The module of claim 30, wherein the lightwave signal is devoid of PMD and the module is used to generate PMD.
33. The module of claim 30, wherein the tuner is a phase-plate.
34. The module of claim 30, wherein each of the first and second portions includes two fixed differential group delay (DGD) segments and a portion tuner for coupling the two fixed DGD segments.

35. The module of claim 34, wherein each of the fixed DGD segments is a birefringent crystal.
36. The module of claim 34, wherein each of the fixed DGD segments is a polarization maintaining fiber.
37. The module of claim 34, wherein the fixed DGD segments in the first and second portions are substantially identical.
38. The module of claim 34, wherein the module tuner and each of the portion tuners are substantially identically tuned.
39. The module of claim 30, also including two fixed phase-plates for respectively coupling the first and second portions to the module tuner, the module tuner and two fixed phase-plates forming a polarization controller.
40. The module of claim 30, wherein the module is fabricated using MEMS technology on a wafer.